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To: Content Analysis Enterprise Team
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FROM: Coryell A. Ohlander, hydrologist

RE: Good Science aspects in UFP
Part 2 regarding stream and riparian health

Goals "... in a unified and cost-effective manner."
Guiding principles: "...consistent and scientific approach...."
Agency Objectives: "...common science-based approach...."
"...test watershed assessment procedures...."
"...implement ... consistent with applicable legal authorities."
"...will base watershed management on good science."
"...science-based total maximum daily loads (TMDLs)."
"...sharing of scientific and technical resources;"
"...monitoring and evaluation...."

Summary Recommendation

As one might guess, "good science" can mean just about anything - and unless the UFP undertakes to define the minimums needed relative to monitoring and evaluation nearly anything will do. It would help if UFP specified what "good science" was in pursuit of or what reports are being targeted. You already have my recommendation that UFP use of S319 as a foundation for a minimum standard report because of its comprehensiveness. I also recommend UFP incorporate EPA's 6 stream health classes into this watershed framework.

Since several States have started to move toward ecosystems for their CWA evaluations, I recommend that UFP adapt the stream health structure to the riparian corridor to encompass both vegetation and wildlife.

Support

The notion that UFP wants to "test" procedures is great, but prompts the question "against what?" What is the yardstick? By law, biological integrity includes three dimensions: diversity, ecosystem stability, and productivity. I think any UFP statements that hinge around "good science" will require standard definition of these three end-points. If UFP adopts EPA's 6 definitions, along with a scale for productivity, then there is a ready-made structure against which to test for objectives such as cost-effectiveness, accuracy, and training. The determination of system health according to predefined definitions would help reduce (maybe eliminate) the spontaneous creation of so many roll-your-own evaluations.

Given that the States have the opportunity to create their own structure for designated uses, the problem for UFP is to end up with a structure that can be unified, consistent, and common science-based, at the same time it is consistent with ***numerous*** applicable legal authorities. Even Harry Houdini would have trouble with this one - every State has taken it upon itself to create its own particular structure for designated uses and its own list of biological parameters. To make matters worse, different divisions of EPA periodically change their own rules; and there is no commonality with S404 evaluations nor is there evidence that EPA, COE, or USF&WS even talk to each other (I don't know anything about NMFS; maybe they do). But the pattern is not good and shows an incredible waste of taxpayer resource.

In anticipation of UFP, Keith McLaughlin, FS WO Program Leader for Water Quality and Hydrology, requested R-2 and R-3 host a national review of the stream health effort known generally as T-Walk (Thalweg-Watershed Area LinK). Under the supervision of Suzan Hixson and Chic Spann, I presented the following review regarding the water quality programs for several States to determine, first, what the States are moving toward, and second, to determine if the 6 stream health classes used in T-Walk were still viable for monitoring and evaluation.

But before you can do anything with the State list, you will need to know what T-Walk used in its stream health classes. The rationale is based on legislative mandates for biological integrity made up of three parts: diversity, ecosystem stability, and productivity.

Watershed Waterbody Health

How and what the State may use as criteria for analysis of waterbody health may change from year to year. The best way to avoid the confusion caused by changes in definitions is to define waterbody health in sufficient biological detail that is both generic in language as well as legally based. Then stream miles and lake acres can be added up to whatever grouping the State requests with less hassle.

Further, for monitoring to be usable in a land management context, the various effects and functions need to be 1) easily summarized and 2) useful through the entire range of biological conditions. Four steps were used in defining waterbody health: 1) select a useful number of categories and titles that define incremental risk; 2) define each category using aquatic diversity and ecosystem stability descriptors; 3) define each category using aquatic productivity measurements; and 4) combine both into an ecological stream health classification based on the response of biological communities to environmental changes. These steps are treated in more detail as follows:

Categories and Titles - A review of several ecological and water quality classification systems (40) indicated that 6 levels of definition have enough flexibility to scale both impact and incremental risk in system response from complete health to ecosystem death. The term "resource use" means the interaction of human use with natural impacts including drought, wind, insects, disease, fires, floods, and land slides. Although none of the classifications used these exact words, each had their own counterpart:

Robust - having or exhibiting strength or vigorous health; flourishing condition. Syn: healthy (Webster). No resource use changes are required; all systems are in balance; natural processes are effectively assimilating management generated effects.

Adequate - sufficient for a specific requirement; lawfully and reasonably sufficient. Syn: sufficient (Webster). Resource use with a few areas sacrificed or lost to production to locate facilities and effectively manage the area. The impact is small and takes up only those sites required for effective use of entire area, such as a mixing zone below a effluent discharge point or the stream destruction at road crossings. Adequate means

legally changed to lesser quality; but not carte blanche authority to reduce Robust health. No agency has that authority.

Diminished - made smaller; lessened; reduced; (as in size, degree, importance, etc). Syn: decrease (Webster). Natural systems are stressed in ways that point to much more severe decline if management does not back off. The damage is relatively slight and natural systems are expected to recover rapidly if given the chance.

Impaired - made worse by or as if by diminishing in some material way; damage. Syn: injure (Webster). Natural systems are clearly pushed too hard. The damage is substantial and natural systems are expected to eventually recover previous diversity and productivity if given enough time.

Precarious - characterized by a lack of security or stability that threatens with danger. Syn: dangerous (Webster). Natural systems have been pushed to the limit. The natural system ingredients are still in place; recovery is possible with substantial costs for restoration. Further stress will collapse the system.

Catastrophic - utter failure; calamity. Syn: disaster. (Webster). Natural systems have been pushed beyond their limits and the existing site quality has been destroyed. The land management phase is now concerned with failure and liability with substantial resources going to on- and off-site damage control and to rebuild the natural system.

Aquatic Diversity - Using these six general classes, aquatic diversity can be merged with ecosystem stability under the concept that a stable ecosystem tends to have all niches fully occupied by appropriate species; no species become extinct; and none reach epidemic proportions for long enough to destroy the niches of other species. (Preston 1969 Wildland Planning Glossary p65 (41 42). The classification scheme developed by EPA (43) provides a suitable framework. The EPA scheme uses a community structure approach to incorporate trophic structure, stability, and diversity. Table 1.4 "Aquatic Life Health Classes" displays the class attributes.

Table 1.4. Aquatic Life Health Classes *

Class	Attributes
Robust	Comparable to the best situations unaltered by humans; all regionally expected species for the habitat and water body size, including the most intolerant forms, are present with full array of age and sex classes; balanced trophic structure.
Adequate	Fish and macroinvertebrate species richness somewhat less than the best expected, especially due to loss of most intolerant forms; some fish species with less than optimal abundances or size distributions; trophic structure shows some sign of stress.
Diminished	Fewer intolerant forms of fish and macroinvertebrates are present. Trophic structure of the fish community is more skewed toward an increasing frequency of omnivores; older age classes of top carnivores may be rare.
Impaired	Fish community is dominated by omnivores; pollution tolerant forms and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; hybrids and diseased individuals may be present. Pollution tolerant macroinvertebrates are often abundant.
Precarious	Few fish present, mostly introduced or very tolerant forms; hybrids common; disease, parasites, physical damage, and other anomalies regular. Only tolerant forms of macroinvertebrates are present.
Catastrophic	No fish, very tolerant macroinvertebrates, or no aquatic life. Ecological upset and collapse; retrogression.

* EPA. 1983. Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses. Office of Water Regulations & Standards, Wash. D.C. 20460. Pg V-4. (EPA names were converted to these class adjectives.)

Aquatic Productivity - The evaluation of productivity in stream health starts with the concept of ecological carrying capacity: "the number (or weight) of organisms of a given species and quality that can survive in, without causing deterioration of, a given ecosystem through the least favorable environmental conditions that occur within a stated interval of time". (Ford-Robertson 1971 Wildland Planning Glossary p40 (41 42).

The numerical thresholds for six production classes are based upon long term natural conditions. Production changes are indexed on a ratio scale of 0 to 1 calculated as projected (or existing) divided by expected production under long term natural - Reference - conditions (42). The terms are commensurate, the ratio dimensionless, and "1" is the best ratio. The production ratios are:

Robust production ratio range:	1.0 to 0.9 of Reference Condition.
Adequate* " " "	<0.9 to 0.7 " "
Diminished " " "	<0.9 to 0.7 " "
Impaired " " "	<0.7 to 0.5 " "
Precarious " " "	<0.5 to 0.3 " "
Catastrophic " " "	<0.3 to 0 " "

* Adequate only applies to legally impacted stream reaches.

Stream Health Classes - Stream health is a combination of ecosystem stability and diversity as defined by the aquatic life health class; and production as defined by the ecological carrying capacity ratio. The combinations for both dimensions are shown in Table 1.5 - Stream Health Classes. Notice that the class is defined by the lowest of the two dimensions. For example, a stream with 'Robust' aquatic life and 'Diminished' production would be declared 'Diminished' Stream Health. The two scales are not averaged; the basic idea of defining limiting factors is valuable for understanding restoration factors and preventing further damage.

Table 1.5 Stream Health Classes
(Combination of aquatic life health and carrying capacity ratios)

Aquatic Life Health Class	Ecological Carrying Capacity Ratios 1.0-0.9	<.9-0.7	<.9-0.7	<.7-0.5	<.5-0.3	<.3
Robust	ROBUST	ADEQUATE*	Diminishd	Impaired	Precarious	Catastrph
Adequate	ADEQUATE*	ADEQUATE*	Diminishd	Impaired	Precarious	Catastrph
Diminished	Diminishd ---------->			Impaired	Precarious	Catastrph
Impaired	Impaired ---------->				Precarious	Catastrph
Precarious	Precarious ---------->					Catastrph
Catastrophic	Catastrph ---------->					

* Adequate only applies to legally impacted stream reaches.

The following material, dated April 1999, first addresses the question of EPA and State current water quality efforts and, second, whether EPA's 6 health classes (i.e. T-Walk) are still viable monitoring and evaluation efforts.

TITLE: Current use of biological indicators and ecosystem health in State water quality assessments and management programs such as S305 & S319.
AUTHOR: C.A. Ohlander
DATE: 4/22/1999 COMPUTER: MW/state indicators

PERSPECTIVE:

T-Walk Stream Health and Riparian Health assessments are aimed at biological scales appropriate to the ecological integrity mandated by CWA. In particular, CWA S404 makes changes in special aquatic sites a primary land management planning and assessment issue for basin and watershed scale cumulative effects. The efforts to build and implement these tools are substantial and require long-term commitments. Since the Forest Service will remain a regulated agency, we need to know what EPA and the States are currently exploring and to anticipate what the most demanding requirements are likely to be so limited resources are not wasted.

The last review of this kind was done in 1987 just after passage of CWA S319. However, with the current WO interest in T-Walk and its supporting legal framework, it seems appropriate to again check to see if continued efforts needed for Stream Health/Riparian Health are good long-term investments.

Riparian Health was not a Designated Use issue in 1987; but it is now part of Designated Uses (i.e. wildlife or waterfowl habitat) for several States. Which lends impetus to full development of Riparian Health assessment and training.

Regions with multiple States and tribes, such as R-2 and R-3, do not have the luxury of creating individual programs for each State or Tribe and therefore try to operate effective programs that will meet the needs of everyone. That means determining the most demanding requirements for both current and future expectations and building programs to deliver the necessary information. The trend for EPA and State water quality agencies has been toward ecological integrity and away from a structured list of numeric parameters.

METHODS:

1) Review the compilation "State Environmental Goals and Indicators Activity." This compilation is 29 pages of detail as issued from the States and summarized by EPA. The material is not dated but references material in 1995 and 1996.

2) Terms abbreviations
CER -- Comparative Environmental Risk analysis.
NEPPS -- National Environmental Performance Partnership System

RESULTS: **What are the States working on for future applications?**

This list summarizes expected future assessments and reporting:

1) Baseline
2) Bioassessment
3) Biological health
4) Comparative Environmental Risk
5) Designated uses

6) Ecosystem health
7) Information display
8) Watershed cumulative effects
9) National Environmental Performance Partnership System
10) Hydrology and hydrologic modification
11) Watershed reports

The summary statements below reflect a composite from all States that may have dealt with the issue; but, not every State had the same perspective or concern. There are several key points or directions to anticipate for the future of water quality evaluation. It should be apparent that the Clean Water Act and the necessary reporting creates a legal net over all land use and corresponding activities of National Forests. Appendix A carries a brief of State comments.

1) Baseline: long-term data benchmark and trends, including land use.

2) Bioassessment: (biocriteria) to supersede chemical assessment as primary evaluation; expect core set of indicators accountable in long-term. Aquatic and wildlife habitat assessment key. Zooplankton and phytoplankton (community) bioindicators. Place-based GIS juxtapose land uses with biocriteria assessment. Statistically valid monitoring.

3) Biological health: status, trends, integrity. Set up long-term monitoring reference stations within every major ecoregion. Aquatic and water dependent species (individual) and population viability. Species composition changes. Native species including endangered species reintroduction. Submerged aquatic vegetation restoration.

4) Comparative Environmental Risk: EPA models will tend to set the standard for environmental risk assessment. EPA specific model in developing and tracking indicators.

5) Designated uses: increased definition for reference/benchmarks.

6) Ecosystem health: becomes focus for water quality planning, monitoring, and political relevance; ecosystem management-based river basin strategic plans. Place-based ecosystem management (GIS planning and analysis).

7) Information display: biological and chemical accounts, ecosystem health for annual reporting to public, shareholders, decision-makers to measure progress. Programmatic and site-specific, basic and simple.

8) Watershed cumulative effects: Land management within each watershed based on constraints & opportunities for air quality, water quality, and land & soil quality. Identified land use activities. Management effectiveness and compliance management (programmatic, project, permit). Nutrient loading. Losses in open space and protected land. Osprey & other birds of prey. Wildlife and neotropical birds. Place-based GIS juxtapose land uses with biocriteria assessment. Multimedia pollutant disposal, loading, release, trends. Focus on accelerated pollution prevention and effectiveness of protection measures. Restoration and protection of aquatic, wetland, and riparian systems.

Solid and hazardous waste generation, prevention, site cleanup. Sustainable development and benchmarks. Toxics reduction. TRI emissions. VOC (gw). Statistically valid monitoring.

9) National Environmental Performance Partnership System: Risk assessment. Performance based budgeting measures. Process for Environmental Assessment and Quality (PEAQ). Programmatic performance indicators.

10) Hydrology and hydrologic modification: Water flow, quantity, and stage. Water withdrawals and diversions.

11) Watershed reports: 303(d), 305(b), 319. Water quality assessment. Watershed and tributary implementation. Watershed based public survey and environmental assessment. Watershed management initiatives. Wetlands trend analysis for loss, location, type, and cause. Stream health relative to Designated Use benchmark (reference). Stream miles by classes of impaired reaches. Statistically valid monitoring.

APPENDIX A: Detail of state program goals and indicators related to CWA.

EPA: has funded major efforts in environmental indicators; CER; NEPPS.
Alabama: no formal environmental indicator system yet.
Alaska: [human] Community Report Card; CER.
Arizona: CER; biocriteria, compliance management (programmatic indicators); 305b assessment measures; ground water indicators, NEPPS.
Arkansas: waiting for EPA's core list.
California: focus on prevention; pollutant release trends; species composition changes; bioassessment; Mussel Watch program; bioindicators (toxics); California Environmental Resources Evaluation System (CERES).
Colorado: Process for Environmental Assessment and Quality (PEAQ) (air quality, water quality, and ecosystem quality); NEPPS.
Connecticut: actual conditions of air, water, land and wildlife.
Delaware: no formal statewide indicator process; wetlands trend analysis for loss of acreage, where losses are occurring, type of wetlands affected, and the causes of the loss; NEPPS.
Florida: paradigm shift over to ecosystems; CER; ecosystem management-based river basin strategic plans.
Georgia: solid waste, water quality, hazardous waste, ground water quality, drinking water quality; biological indicators and efficiency measures for designated uses, fecal coliform, water quality trends, biological results, fish contamination, fish advisories, habitat assessment, biological integrity, and reduced pollutant loading; NEPPS.
Hawaii: CER; land, air, water quality;
Idaho: sustainable future;
Illinois: critical trends; baseline indicators; ecosystem- level monitoring; (i.e. forest ecosystem location, extent, and condition); NEPPS.
Indiana: geographical (place-based); no formal process; NEPPS
Iowa: CER;
Kansas: performance-based budgeting with indicators: stream miles by classes of impaired reaches, energy and water use, TRI emissions, contaminated

sites (tank/oil & gas/commercial/industry), per capita solid waste generation, ground water contaminated by landfills, pesticide/fertilizer use and presence in surface water, children with elevated blood lead levels, and contaminated public water supply wells.

Kentucky: CER; environmental indicators; NEPPS.

Louisiana: CER; environmental indicators for air, water, solid and hazardous waste, natural resources, sustainability, and health indicators.

Maine: CER; indicators of sustainable development and benchmarks. GIS juxtapose land uses with biocriteria assessment data.

Maryland: environmental indicators; 40% nutrient reduction goals (nitrogen and phosphorus); submerged aquatic vegetation restoration, fish passage, fisheries management, toxics reduction, nutrient loading index, benthic restoration, zooplankton community environmental indicators, phytoplankton community environmental indicators. Indicators communicated to the public and to provide updates of water quality to the tributary stakeholders effectively. Each watershed and tributary implementation. Indicators which are useful to the public and decision-makers to measure progress; indicators beyond the scope of indicators required by the EPA including zooplankton and phytoplankton bioindicators, nutrient bioassays, restoration goals index for benthic monitoring, and several others.

Massachusetts: resource protection, waste prevention, and waste site cleanup. place-based pilot watershed project; multimedia pollution data; no formal environmental indicators yet; air quality, water quality, loss of open space and protected land, waste generation...

Michigan: no formal indicators.

Minnesota: CER; place-based ecosystem management; sustainable development; environmental indicators; status and trends of environmental health; environmental protection effectiveness, ecoregion "vital signs"; NEPPS.

Mississippi: CER: Water Quality: designated use measures, fish tissue advisories, benthic abundance/diversity, physical/chemical data, permit compliance; Water Quantity: flows and level measures, MGD withdrawals; Air: air quality exceedances, ambient air quality measures; and Hazardous Waste: TRI data.

Missouri: CER; changes in emission/discharge quantities/fuel use; changes in ambient levels/conditions; health/ecological/quality of life effects; and changes in uptake/assimilation/body burden. air, water, soil and land, waste and toxics. There will be 2-7 indicators for each issue that will be generally level 3 or 4 indicators as well as some activity indicators. list of indicators covering nine issues: energy, demographics, soil and land use, biota, air quality, water quality, water quantity, solid waste, and hazardous substances. biological results indicators, but the indicators are more programmatic.

Montana: sustainable; no indicator program;

Nebraska: no current plans for an indicator development process. biological indicators in use;

Nevada: environmental indicators; programmatic performance measures; biological indicators; biodiversity.

New Hampshire: track EPA indicators; keep indicators simple; biological health of waters; CER:

New Jersey: evaluation of land use management. NEPPS; biomonitoring reference stations within every major ecoregion; Benthic macroinvertebrates;. Long-term baseline; biennial 305(b) water quality inventory, watershed management initiative. Planning is mandated to

develop indicators related to economy, environment, infrastructure, intergovernmental coordination and community life. NEPPS.

New Mexico: chloride, oxygen, and VOC (ground water); dissolved oxygen, nitrogen levels, and benthic macroinvertebrate organisms (surface);

New York: ecosystem health rated by degree of integration, political and ecological relevance, complexity of measures, and cost of the measures; level six indicators for wildlife.

North Carolina: air, water, waste, wetlands and marine fisheries.

North Dakota: CER; no formal indicator development process; ground water quality at landfills; mercury levels in fresh water fish.

Ohio: index of biological and chemical indicators to assess stream water quality for 305b reports; relative health of streams; CER; NEPPS;

Oklahoma: wait for EPA specific model in developing indicators.

Oregon: protecting natural resources; EMAP and REMAP; no formal indicator program; NEPPS;

Pennsylvania: no indicator development or use;

Rhode Island: no indicators; plans to develop; living resource indicators of individual species and population viability of species such as the osprey, commercial and estuarine fish, reintroduction of the native species of turkey, and the piping plover (endangered species); invertebrates.

South Carolina: environmental indicators both programmatic and biological indicators. designated uses, fecal coliform, water quality trends, biological results, fish contamination, fish advisories, habitat assessment, biological integrity, and reduced pollutant loadings.

South Dakota: no formal indicator system; biological indicators;

Tennessee biological indicators, no systematic approach. proper and safe disposal of ... pollutants; health risks; risk assessment;

Texas: benchmark study; environmental indicators; NEPPS;

Utah: CER; benchmark system; NEPPS:

Vermont: focus on ecosystems.

Virginia: no formal indicator development; no plans to use indicators. Index of Environmental Quality for annual reporting.

Washington: performance based measures; CER; core set of indicators accountable in long-term; NEPPS;

West Virginia: public survey and an environmental assessment organized by watershed and will be used to manage natural resources within each watershed according to specific constraints and opportunities, physical and otherwise; stream monitoring of fish, invertebrates, and water quality (not considered statistically valid). no formal indicator development and no use of indicators.

Wisconsin: has environmental indicators re planning, review, and monitoring; NEPPS;

Wyoming: no formal environmental indicator development process; moving from chemical assessment water quality to biological components to measure environmental change.

TITLE: **Review of State Designated Use Classifications**
AUTHOR: C.A. Ohlander
DATE: 4/19/99

PURPOSE: How do the 6 stream health classes used in T-Walk match to the current State Designated Use Classes?

PERSPECTIVE: Using a consistent set of biological definitions for stream health provides an efficient framework for environmental assessment, cumulative effects analysis, and reporting. The worst alternative is to have a different set of field definitions for each State. To be efficient the definitions must be detailed enough to satisfy the State Designated Uses, blend with EPA's ever changing structure for S305(b) and S319 reports, flexible enough to adjust to changes in accounting rules, and be sensitive to real changes in biological parameters as addressed by the Clean Water Act.

This was the perspective of the stream health definitions (Part 1 Legal Framework) and derived from EPA's 1983 Water Body Assessment. Given the T-Walk national review, it is again time to review criteria for impairment and Designated Uses for several States to see if the current Stream Health definitions (and assessment approach) are still valid.

BACKGROUND:

1) Nearly every State has a different and periodically changing set of aquatic life designated use classifications. To make matters worse, the evaluation criteria for impairment promoted by EPA changes every few years (usually in concert with S305b guidance). For an agency like the Forest Service with responsibilities in nearly all States, the problem of providing suitable responses to S305 or 319 reports to each State takes on nightmarish proportions.

2) The purpose in selecting the 6 classes for biological health (derived from EPA Water Body Assessment 1983) was to provide a consistent set of definitions across Regions 2 and 3 for field use and yet be able to provide good data for individual State classifications as needed. The original review was done in 1983 for the 9 states that pilot tested EPA's Water Quality Standards Handbook. The States that participated in EPA's study requested EPA to provide, among other things, a set of biologically based definitions that could be applied nationally. The intent was not to replace the States Designated Uses but provide a scale of impact that could be used within a Designated Use. A biologically based scale internal to any aquatic life Designated Use was an attractive alternative to a hodgepodge of separate criteria for each State in the Region.

3) In 1990, EPA issued biological criteria that asked States to evaluate miles of streams for designated use classified as ***comparable, fully supporting, partially supporting, or non-supporting.*** In 1995, these were changed to just *full support, partial support, non-support*. The classification *comparable* referred back to a fully natural setting and would be called "robust" but not "adequate."

4) S404 includes definitions of "waters of the United States:"
Navigable waters, aquatic environments, and aquatic ecosystems that serve as habitat for interrelated and interacting communities and populations of plants and animals are all "waters of the U.S." This includes waters and impoundments such as lakes, rivers, streams, intermittent streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds; or their tributaries (CWA S502(7) & 40 CFR 230.3(c&s)).

5) Additionally, definitions for "special aquatic sites", including wetlands, also play a major part in the CWA S404 regulatory framework; they are paraphrased as:
Special aquatic sites have special characteristics of productivity, habitat, wildlife protection, or other important or easily disrupted ecological values. They include sanctuaries, refuges, wetlands, mudflats, vegetated shallows, coral reefs, and riffle and pool complexes (40 CFR 230.3(q-1)).

6) State may also add "waters of the State" to the federal list.

7) "Significant degradation" requires a factual evaluation of potential impacts on physical, chemical, and biological characteristics, special aquatic sites, and on human uses. Significant adverse effects are measured through impacts on municipal water supplies, plankton, fish, shellfish, wildlife, and special aquatic sites; on life stages of aquatic life and other wildlife dependent on aquatic ecosystems; on aquatic ecosystem diversity, productivity, and stability; and the effects may include loss of fish and wildlife habitat, or the loss of the capacity of a wetland to assimilate nutrients, purify water, or reduce wave energy (40 CFR 230.10(c)).

8) The six stream health classes -- *robust, adequate, diminished, impaired, precarious, catastrophic* -- have served well for R 2 & 3. And the central idea has been extended to riparian health.

9) In July, T-Walk, its legal foundations, and logic will be reviewed as a potential nationally supported system. A key point is whether the existing six stream health classes are still sufficiently detailed to meet the needs of the Forest Service across all Regions and Areas.

10) Proposed EPA regulations at 30 CFR 131 suggest the States will need to refine their designated uses. Current regs allow a State to create subcategories, but does not mandate that it do so. The expectation is that aquatic designated uses with be expanded to match more of the categories in the existing "waters" list.

METHODS:

1) Review selected State aquatic life designated uses and look for points that are not or could not be satisfied by 6 stream health classes.

2) The tabulation looks at a sample of 12 States and 1 Tribe with a wide range of ecosystems and program levels.

RESULTS:

Designated uses were sorted and combined to select most detailed. 13 States/Tribes involved. Stream Health abbreviations Rob, Ade, Dim, Imp, Pre Cat (RA DI PC is expected split for Full, Partial, Non-support)

DU Support
Ful Prt Non :

A DI PC : Good Class III (same aquatics as I & II) CIR
A DI PC : Warm water semi-permanent fish life propagation SD
C - - : effluent dependent waters AZ
C - - : Limited resource water (no expected aquatic life) OH
D I PC : Cold water marginal fish life propagation SD
D I PC : Fair Class IV (fish migration) CIR
D I PC : Growth & marginal propagation - (Salm & non-salmonids) MT
D I PC : Limited warm water fishery NM
D I PC : Limited warm water OH
D I PC : Marginal cold water fishery NM
I P C : Warm water marginal fish life propagation SD
I P C : Growth & propagation - impacted fish, aquatics, wtrfowl,& fur bearers MT
R A C : Modified warm waters OH
R A DIPC: preservation of biological habitats of special significance CA
R AD DIPC: rare, threatened, and endangered species CA
R AD IPC : Exceptional warm water OH
R AD IPC : Extraordinary Cls I (fish & shellfish migr rear spawn). Wildlife Hab CIR
R AD IPC : High quality cold water fishery NM
R AD IPC : High quality fisheries waters (cold & warm) SD
R AD IPC : outstanding natural resource waters LA
R AD IPC : Propagation & main healthy well balanced population fish & wildlife. FL
RA DI PC : Aquatic and wildlife AZ
RA DI PC : aquatic life NC
RA DI PC : aquatic life production OR
RA DI PC : aquatic life support UT
RA DI PC : cold freshwater habitat CA
RA DI PC : Cold water aquatic life SD
RA DI PC : cold water fish & other indigenous aquatic life & wildlife MI
RA DI PC : cold water fisheries AZ
RA DI PC : Cold water fisheries MT
RA DI PC : Cold water fishery NM
RA DI PC : Cold water OH
RA DI PC : Cold water permanent fish life propagation SD
RA DI PC : ephemeral waters AZ
RA DI PC : estuarine habitat CA
RA DI PC : Excellent Cls II (fish & shellfish & crayfish m,r,s,h) Wildlife habitat CIR
RA DI PC : fish and wildlife propagation LA
RA DI PC : Fish and wildlife propagation SD
RA DI PC : ground water recharge CA
RA DI PC : Growth & propagation -(Salmonids & non-salmonids) MT
RA DI PC : inland saline water habitat CA
RA DI PC : marine habitat CA

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RA  DI  PC  : migration of aquatic organisms CA
RA  DI  PC  : other aquatic life (non-fish thrive and reproduce) MI
RA  DI  PC  : oyster propagation LA
RA  DI  PC  : Seasonal salmonid OH
RA  DI  PC  : shell fish harvesting CA
RA  DI  PC  : spawning, reproduction, early development CA
RA  DI  PC  : warm freshwater habitat CA
RA  DI  PC  : Warm water aquatic life SD
RA  DI  PC  : warm water fish & other indigenous aquatic life & wildlife MI
RA  DI  PC  : warm water fisheries AZ
RA  DI  PC  : Warm water fisheries MT
RA  DI  PC  : Warm water fishery NM
RA  DI  PC  : Warm water permanent fish life propagation SD
RA  DI  PC  : wildlife (support of indigenous species of fish & waterfowl) LA
RA  DI  PC  : wildlife habitat CA
RA  DI  PC  : wildlife NC
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Summary Count of stream health patterns

A	DI	PC	2	
C	-	-	2	Habitat marked 9 times
D	I	PC	7	Wildlife marked 11 "
I	P	C	2	Propagation marked 12 "
R	A	DIPC	4	
R	AD	IPC	4	
RA	DI	PC	37	

CONCLUSION:

1) The definitions promoted by EPA's Waterbody Assessment Manual (the 6 health classes used in T-Walk for both stream and riparian) seem to fit the myriad of "waters" and special aquatic sites. These definitions would also apply to lakes and impoundments but there has been no effort in T-Walk to include flat water.

2) The question raised by Keith McLauglin concerning the application of T-Walk to other areas and stream systems can be answered "yes" in so far as the legal structure is concerned and the application of these 6 stream health definitions.

3) For the application of particular assessment tools, it is appropriate to check each of the "waters" and special aquatic sites against the tools to see what is the most cost effective application. I expect that to vary throughout the country. ....

4) State Designated Uses clearly separate cold water species from warm water species. The fundamental evaluations should start with the U.S. Fish and Wildlife Service tools such as Habitat Suitability models. This step would help define optimum conditions that could be used as a reference if natural sites were not available.

5) What changes are needed in Stream Health definitions?

There are no glaring holes in the 6 Stream Health definitions. Since they deal with biological health, they meet, at least on the surface, the expected increased future use of more holistic biological integrity. They would also appear to satisfy the need for information display that is basic and simple.

However, since the future is expected to result in more detailed Designated Uses, the question is whether the 6 point scale will continue to satisfy the breakdown in assessment reporting for full, partial, or non-support categories. Also, since EPA has changed their mind at least once since 1990, the future categories might be returned to the four categories they started with: comparable, full, partial, and non-support. Four categories of support associated with each of the designated aquatic uses appears to be the most demanding task. Given the original definition of *comparable*, this category would always be Robust -- as an expression of the CWA optimistic goal.

Unfortunately, I expect there will never be consistency among the States as to how many aquatic life designated uses they have or how they are defined and measured. We can see our way clear if the States define what constitutes "full support" (or "comparable") for each of their designated uses -- which becomes our "Robust" -- and allows us to slide the other 5 stream health classes into whatever support classes are needed. I do not expect perfect matches, but with 6 classes the extrapolation should be pretty good.

Appendix A reflects aquatic and wildlife Designated Uses for 12 States and the Colville Indian Reservation. There are a total of 58 DU's represented for which Stream and Riparian Health classes are assigned to the EPA categories of Full, Partial, and Non-support. A summary of counts are as follows:

		Full	Partial	Non-Support
37	allow a simple 3 way split	RA	DI	PC
4	require Rob Ade separates	R	A	DIPC
4	require Rob separates	R	AD	IPC
2	allow an Adequate Reference	A	DI	PC
7	allow a Diminished Reference	D	I	PC
2	allow an Impaired Reference	I	P	C
2	allow a Catastrophic Reference	C	-	-

I think this supports the contention that 6 Stream Health classes are necessary but there is no current need to make more classes.

6) What changes are needed in Riparian Health definitions?

Not enough information available to tell. It does appear that the current Riparian Health definitions are strongly based for current use and as a solid foundation for the future. That is, given these State perspectives, the riparian definitions anticipate most, if not all, of the future applications.

There does not appear to be the need for major shifts and the refinement expected through normal day-to-day use will be adequate to meet all future reporting and evaluation needs.

The Riparian definitions are essential to the evaluation of Designated Uses. Of the 58 Designated Uses explored, 11 were directly tied to wildlife with 3 using wildlife and habitat together.

I believe the 6 Riparian Health classes are essential to meeting data and assessment requirements for State water quality agencies. My guess is that such an effort will also meet assessment requirements under other laws such as the Endangered Species Act. Over time and as field people get a chance to use them, changes will occur. All to the good.

Riparian Health (extract from T-Walk Part 11)

The scope of cumulative effects measured under S404b1 criteria (40 CFR 230) is driven by the fact that even minor changes in floodplain, wetland, or riparian function often trigger major impairment because of long term reduction in the watershed capacity to retain and store flood water or protect upland areas from erosion. Biological functions are part of these evaluations. The scope of the wildlife effort (40 CFR 230.30 & 32) is dictated by concerns for resident and transient, aquatic and terrestrial, mammals, birds, reptiles, and amphibians. And there is special legal emphasis on threatened or endangered species and any related critical habitat (50 CFR 17.11).

Elements of the evaluation include plant productivity and diversity; adequate good quality water; spawning and maturation areas and protective cover for aquatic species; adequate and reliable supply of preferred food sources; breeding, nesting, and resting areas for migratory birds; escape cover and travel corridors for transient species; possible sources and potential bioaccumulation of contaminants; possible physical or chemical factors that favor the introduction of undesirable plant and animal species; or possible loss of plant and animal species diversity that disrupt the normal functions of the ecosystem and lead to reductions in overall biological productivity.

Both inventory and operational definitions need to be compatible with specific mitigation for plant and animal populations (40 CFR 230.75). That is, to have the data to support the following (FONSI) statements:

a) Project does not modify water current and circulation patterns which would interfere with the movement of animals.
b) Project does not create habitat conducive to the development of undesirable predators or species which have a competitive edge ecologically over indigenous plants or animals.
c) Project avoids sites with unique habitat or other value, including habitat of threatened or endangered or sensitive species.
d) Project provides habitat development and restoration to produce a new or modified environmental state of higher ecological value.
e) Project provides habitat development and restoration to minimize adverse impacts and to compensate for destroyed habitat.
f) Project uses techniques that have been demonstrated to be effective in circumstances similar to those under consideration.
g) Project uses new and untested techniques which will be tested on a small scale to allow corrective action if unanticipated adverse impacts occur.
h) Activities that create unpreventable impacts will be scheduled to avoid biologically critical time periods such as spawning or migration periods.
i) Project avoids the destruction of remnant natural sites.

Riparian Health Definitions

Following the line of thought opened by S404b1 guidelines, it is apparent that an evaluation of riparian health is essential to cumulative effects analysis. It is also apparent that there are lots of pieces, a high degree of complexity, and a major lack of knowledge. However, any evaluation requires a commitment to standard definitions and for this there is no more consensus than there was in 1974 when the issue first came up. So with stout heart and girded loins, Jim Cooper and his compatriots in R-3 leaped into the breach and developed riparian health definitions. While the universe has not yet shouted its acclaim, the R-3 riparian definitions have the advantage that they build on those used for stream health, are compatible with S404b1 guidelines, and more or less complementary to USF&WS habitat assessments made under HEP and HSI protocols. We can see how this plays out since these definitions were used as part of the Biological Assessment for R-3's T&E aquatic species.

Riparian Health is a combination of Stream Health Class and Terrestrial Vegetative Health Class. It is defined by the lowest of two scales; i. e., Robust Stream Health Class and Impaired Terrestrial Vegetative Health Class equals Impaired Riparian Health.

Table 11.1 Riparian Health Classes
(Combination of Stream Health and Terrestrial Vegetative Health Class)

Stream Health Class	Terrestrial Vegetative Health Class					
	Robust	Adequate	Diminishd	Impaired	Precarious	Catastrph
Robust	ROBUST	ADEQUATE	Diminishd	Impaired	Precarious	Catastrph
Adequate	ADEQUATE	ADEQUATE	Diminishd	Impaired	Precarious	Catastrph
Diminished	Diminishd	---------->		Impaired	Precarious	Catastrph
Impaired	Impaired	---------->			Precarious	Catastrph
Precarious	Precarious	---------->				Catastrph
Catastrophic	Catastrph	---------->				

Terrestrial Vegetative Health Class (Relative to the Stream Type and Hydro-Physiographic Regime)

Robust: Having or exhibiting strength or vigorous health; flourishing condition (Webster). Comparable to the best situations unaltered by man; all regionally expected species for the habitat and water body size, including the most intolerant forms, are present with full array of age and sex classes; balanced trophic structure. Riparian zone has achieved potential extent.

Adequate: Lawfully and reasonably sufficient for a specific requirement (Webster). Vegetative and wildlife species richness somewhat less than the best expected situation, especially due to loss of most intolerant forms; trophic structure shows some sign of stress. Vegetation present indicates maintenance of riparian soil moisture characteristics. Adequate vegetation (65 to 75 % cover) present to prevent surface soil erosion, to protect banks, and dissipate energy during most flow events and rain events. Riparian zone has nearly achieved potential extent.

Diminished: Made smaller lessened; reduced; -as in size, degree, or importance (Webster). Fewer intolerant forms of vegetation and wildlife are present. Trophic structure is skewed toward stress.

Vegetation present indicates maintenance of riparian soil moisture characteristics in most areas. Vegetation present (50 to 65 % cover) to prevent surface soil erosion, protect banks, and dissipate energy except during moderate to high flows and rain events. Riparian zone noticeably narrower than optimum, but greater than 50 percent of optimum.

Impaired: Made worse; diminishing in some material way (Webster). Vegetative and wildlife communities are dominated by habitat generalists; growth rates and condition factors commonly depressed. Vegetation present indicates non-maintenance of riparian soil moisture characteristics in all but the wettest areas. Vegetation present (25 to 50 % cover) inadequate to prevent surface soil erosion, protect banks, and dissipate energy during flows greater than bank full and moderate or greater rain events. Riparian zone narrower than 50 percent of optimum, but greater than 25 percent of optimum.

Precarious: Lack of security or stability that threatens with danger (Webster). Few plant species present, mostly introduced or very tolerant forms. Species present indicate non-maintenance of riparian soil moisture characteristics. Vegetation present (10 to 25 %) inadequate to prevent surface soil erosion, protect banks, and dissipate energy except during low flows or weak rain events. Riparian zone narrower than 25 percent of optimum.

Catastrophic: Complete failure; calamity (Webster). No vegetation except for annuals; wildlife few in number and diversity consisting of occasional drop-ins. Ecological upset and collapse; retrogression. No maintenance of riparian soil moisture characteristics. Vegetation not present in quantity or quality to prevent surface soil erosion, protect banks, and dissipate energy during any flows or rain events. Riparian zone absent.

APPENDIX A: Designated Use Response by Selected States

Arizona: with and without fisheries
Aquatic and wildlife:
cold water fisheries
warm water fisheries
ephemeral waters
effluent dependent waters

New Mexico:
Cold water fishery
High quality cold water fishery
Marginal cold water fishery
Warm water fishery
Limited warm water fishery

South Dakota:
Cold water aquatic life
Cold water marginal fish life propagation
Cold water permanent fish life propagation
High quality fisheries waters (cold & warm)
Warm water aquatic life
Warm water marginal fish life propagation
Warm water permanent fish life propagation
Warm water semi-permanent fish life propagation
Fish and wildlife propagation

Ohio:
Limited warm water
Exceptional warm water
Modified warm waters
Seasonal salmonid
Cold water
Limited resource water (no expected aquatic life)

Montana:
Growth and propagation -(Salmonids & non-salmonids)
Growth and marginal propagation - (Salmonids & non-salmonids)
Growth and propagation of fishes and associated aquatic life, waterfowl, and fur bearers. (Re impacted sites)
Cold water fisheries
Warm water fisheries

Florida:
Propagation & maintenance of a healthy and well balanced population of fish and wildlife.

North Carolina:
aquatic life
wildlife

Oregon:
aquatic life production

Colville Indian reservation

Class I (Extraordinary) DU include fish & shellfish (migration, rearing, spawning, harvesting). Wildlife habitat.
Class II (Excellent) DU inc. fish & shellfish (migration, rearing, spawning, harvesting; and crayfish (rearing, spawning, and harvesting)
Class III (Good) same aquatics as I & II
class IV (Fair) fish migration

Calif
- ground water recharge
- spawning, reproduction, early development
- shell fish harvesting
- warm freshwater habitat
- cold freshwater habitat
- inland saline water habitat
- estuarine habitat
- marine habitat
- wildlife habitat
- preservation of biological habitats of special significance
- rare, threatened, and endangered species
- migration of aquatic organisms

Michigan
- other aquatic life (animals other than fish can thrive and reproduce)
- warm water fish & other indigenous aquatic life & wildlife
- cold water fish & other indigenous aquatic life & wildlife

Utah
- aquatic life support

LA
- fish and wildlife propagation
- oyster propagation
- outstanding natural resource waters
  (narratives based on biological and community integrity; uses FS, PS, NS)
- wildlife (support of indigenous species of fish & waterfowl)